

1 **CLAIMS**

2 1. A method of managing multiple inputs that can contend for a single output  
3 comprising:

4 providing a matrix switch object that can process multiple inputs and  
5 provide one or more outputs, one of the outputs comprising a primary output for  
6 which contention can take place between the multiple inputs,; and

7 programming the matrix switch object using a data structure, said  
8 programming resolving contention between the multiple inputs for the primary  
9 output .  
10

11 2. The method of claim 1, wherein the matrix switch object is configured for  
12 use with inputs that comprise data streams.  
13

14 3. The method of claim 1, wherein the matrix switch object is configured for  
15 use with inputs that comprise data streams, said programming enabling at least  
16 portions of at least some of the data streams to be combined.  
17

18 4. The method of claim 1, wherein the matrix switch object is configured for  
19 use with a multi-media editing project in which the inputs comprise data streams  
20 at least portions of which are to be combined.  
21

22 5. The method of claim 4, wherein said data streams comprise video data  
23 streams.  
24  
25

1   **6.**   The method of claim 4, wherein said data streams comprise audio data  
2 streams.

3  
4   **7.**   The method of claim 4, wherein said data streams comprise both video and  
5 audio data streams.

6  
7   **8.**   The method of claim 1, wherein said providing comprises providing a  
8 software-implemented matrix switch object.

9  
10   **9.**   One or more computer-readable media having computer-readable  
11 instructions thereon which, when executed by a computer, implement the method  
12 of claim 1.

13  
14   **10.**   A method of managing multiple inputs that can compete for a single output  
15 comprising:

16       defining a software-implemented matrix switch having multiple input pins  
17 and multiple output pins, the input pins being individually associated with inputs  
18 that can compete, during a common time period, for a particular output pin that is  
19 associated with the matrix switch; and

20       programming the matrix switch using a data structure, said programming  
21 providing a routing scheme for routing input pins to output pins such that at any  
22 given time, only one input pin is routed to the particular output pin.

1 **11.** The method of claim 10, wherein the matrix switch is configured for use  
2 with inputs that comprise data streams.

3  
4 **12.** The method of claim 10, wherein the matrix switch is configured for use  
5 with inputs that comprise data streams, said programming of the matrix switch  
6 providing for the combination of at least portions of at least some of the data  
7 streams.

8  
9 **13.** The method of claim 10, wherein the matrix switch is configured for use  
10 with a multi-media editing project in which the inputs comprise data streams at  
11 least portions of which are to be combined.

12  
13 **14.** The method of claim 13, wherein said data streams comprise video data  
14 streams.

15  
16 **15.** The method of claim 13, wherein said data streams comprise audio data  
17 streams.

18  
19 **16.** The method of claim 13, wherein said data streams comprise both video  
20 and audio data streams.

21  
22 **17.** One or more computer-readable media having computer-readable  
23 instructions thereon which, when executed by a computer, implement the method  
24 of claim 10.  
25

1 **18.** A multi-media editing method comprising:  
2 defining a first data structure that represents a user-defined multi-media  
3 editing project;  
4 providing a software-implemented matrix switch that is programmable to  
5 route multiple switch inputs to multiple switch outputs, at least two of the inputs  
6 being capable of competing for a single output during a common time period, the  
7 single output being configured to provide a data stream defined by the multi-media  
8 editing project;  
9 processing the first data structure to provide a second data structure that  
10 contains data that can be used to program the matrix switch so that multiple switch  
11 inputs are routed to multiple switch outputs; and  
12 operating on the second data structure so that no two inputs are routed to  
13 said single output during a common time period.  
14

15 **19.** The multi-media editing method of claim 18, wherein said providing of the  
16 software-implemented matrix switch comprises providing a switch having virtual  
17 input pins and virtual output pins, the virtual input pins being configured to  
18 receive individual data streams, the virtual output pins being configured to provide  
19 individual data streams.  
20

21 **20.** The multi-media editing method of claim 18, wherein said processing of  
22 the first data structure comprises configuring the matrix switch so that it receives  
23 at least one source stream at one of its inputs.  
24  
25

1 **21.** The multi-media editing method of claim 20, wherein said configuring  
2 comprises building a collection of associated objects operably associated with the  
3 matrix switch and that are configured to process digital data to provide a source  
4 stream at one or more of the inputs.

5  
6 **22.** The multi-media editing method of claim 21, wherein at least some of the  
7 associated objects comprise filters.

8  
9 **23.** The multi-media editing method of claim 18, wherein said processing of  
10 the first data structure comprises providing at least one object configured to  
11 receive at least one output stream from the matrix switch, process the output  
12 stream to provide an input stream, and provide the input stream to an input of the  
13 switch.

14  
15 **24.** The multi-media editing method of claim 23, wherein said object  
16 comprises a transition object that is configured to transition between at least one  
17 source stream and at least one other source stream.

18  
19 **25.** The multi-media editing method of claim 23, wherein said object  
20 comprises an effect object that is configured to operate on a source stream to  
21 produce a different source stream.

1 **26.** The multi-media editing method of claim 23, wherein said object  
2 comprises a mix object that is configured to mix multiple audio or video source  
3 streams.

4  
5 **27.** The multi-media editing method of claim 18, wherein said defining of the  
6 first data structure comprises defining a hierarchical tree structure.

7  
8 **28.** The multi-media editing method of claim 27, wherein the hierarchical tree  
9 structure comprises nodes that represent tracks, each track being associated with  
10 one or more data stream sources.

11  
12 **29.** The multi-media editing method of claim 28, wherein the data stream  
13 sources with which one or more of the tracks are associated comprise video data  
14 stream sources.

15  
16 **30.** The multi-media editing method of claim 28, wherein the data stream  
17 sources with which one or more of the tracks are associated comprise audio data  
18 stream sources.

19  
20 **31.** The multi-media editing method of claim 28, wherein the data stream  
21 sources with which one or more of the tracks are associated comprise both video  
22 and audio data stream sources.

1 **32.** The multi-media editing method of claim 18, wherein said processing of  
2 the first data structure to provide the second data structure comprises processing  
3 the first data structure to provide a grid structure,

4 the grid structure containing multiple rows, individual rows representing  
5 inputs of the matrix switch and being associated with individual data stream  
6 sources,

7 each row containing at least one value that is associated with an output  
8 associated with said single output of the matrix switch.

9  
10 **33.** The multi-media editing method of claim 32, wherein said operating on the  
11 second data structure comprises changing at least one value in at least one of the  
12 rows of the grid structure.

13  
14 **34.** The multi-media editing method of claim 18, wherein said processing of  
15 the first data structure comprises configuring the matrix switch so that it receives  
16 multiple source streams at multiple respective inputs at multiple times.

17  
18 **35.** The multi-media editing method of claim 34, wherein said configuring  
19 comprises building one or more filter graphs that are individually configured to  
20 process digital data to provide multiple respective source streams, and associating  
21 one or more filter graphs with individual inputs of the matrix switch.

22  
23 **36.** The multi-media editing method of claim 35, further comprising building  
24 multiple sub-graphs inside one or more of the filter graphs.  
25

1 **37.** One or more computer-readable media having computer-readable  
2 instructions thereon which, when executed by a computer, implement the method  
3 of claim 18.

4  
5 **38.** One or more computer-readable media having computer-readable  
6 instructions thereon which, when executed by a computer, cause the computer to:

7       define a multimedia editing project responsive to input received from a  
8 user;

9       represent the editing project as a hierarchical tree structure;

10       process the hierarchical tree structure to provide a grid structure containing  
11 data that defines an association between inputs, outputs and a time line defined by  
12 the editing project;

13       provide a matrix switch having multiple inputs and multiple outputs that  
14 correspond to the respective inputs and outputs of the grid structure; and

15       use the grid structure to program routing of the matrix switch's inputs to the  
16 matrix switch's outputs for the given time line.

17  
18 **39.** The computer-readable media of claim 38, wherein the multi-media editing  
19 project operates on one or more multiple video data streams.

20  
21 **40.** The computer-readable media of claim 39, wherein the multi-media editing  
22 project operates on the one or more multiple video data streams by combining two  
23 or more video streams.  
24  
25



1 **41.** The computer-readable media of claim 38, wherein the multi-media editing  
2 project operates on one or more audio data streams.

3  
4 **42.** The computer-readable media of claim 41, wherein the multi-media editing  
5 project operates on multiple audio data streams by combining two or more audio  
6 data streams.

7  
8 **43.** The computer-readable media of claim 38, wherein the multi-media editing  
9 project operates on one or more video and audio data streams.

10  
11 **44.** The computer-readable media of claim 43, wherein the multi-media editing  
12 project operates on multiple video and audio data streams by combining two or  
13 more video data streams and combining two or more audio data streams.

14  
15 **45.** The computer-readable media of claim 38, wherein the multi-media editing  
16 project comprises multiple tracks, each of which is associated with at least one  
17 data stream source.

18  
19 **46.** The computer-readable media of claim 45, wherein the instructions cause  
20 the computer to use the tree structure to prioritize the tracks.

21  
22 **47.** The computer-readable media of claim 46, wherein the instructions cause  
23 the computer to process the tree structure to provide the grid structure by  
24 traversing the tree structure in a predetermined manner.

1 **48.** The computer-readable media of claim 38, wherein the instructions cause  
2 the computer to change at least one data value within the grid structure to ensure  
3 that only one stream is routed to a primary input of the matrix switch at a time.

4  
5 **49.** One or more computer-readable media having computer-readable  
6 instructions thereon which, when executed by a computer, cause the computer to:  
7 represent a multi-media editing project as a first data structure;  
8 process the first data structure to provide a second data structure containing  
9 data that defines an association between inputs, outputs and a time line defined by  
10 the editing project;  
11 provide a matrix switch having multiple inputs and multiple outputs that  
12 correspond to the respective inputs and outputs of the second data structure; and  
13 use the second data structure to program routing of the matrix switch's  
14 inputs to the matrix switch's outputs for the given time line.

15  
16 **50.** The computer-readable media of claim 49, wherein the matrix switch has a  
17 single output that provides a data stream that represents the editing project.

18  
19 **51.** The computer-readable media of claim 49, wherein the matrix switch has at  
20 least one feedback loop coupled between an output and an input.

21  
22 **52.** The computer-readable media of claim 51, wherein the feedback loop  
23 contains a transition element having two or more inputs and a single output, the  
24 transition element being configured to transition between multiple data streams.  
25

1 **53.** The computer-readable media of claim 51, wherein the feedback loop  
2 contains an effect element having an input and an output, the effect element being  
3 configured to operate on a first data stream to provide a second data stream that is  
4 different from the first data stream.

5  
6 **54.** The computer-readable media of claim 49, wherein the first data structure  
7 comprises a tree structure.

8  
9 **55.** The computer-readable media of claim 49, wherein the second data  
10 structure comprises a grid structure.

11  
12 **56.** The computer-readable media of claim 55, wherein the instructions cause  
13 the computer to change one or more data values within the grid structure to ensure  
14 that no two switch inputs are routed to a primary switch output at any one time.

15  
16 **57.** The computer-readable media of claim 55, wherein the instructions that  
17 cause the computer to process the first data structure to provide the second data  
18 structure cause the computer to:

19       define a grid row for each of a number of data stream sources;

20       enter data values in each grid row, the data values being associated with a  
21 time period for which the data stream source desires to be routed to a primary  
22 output of the matrix switch; and

23       change at least one data value in at least a portion of a grid row if a  
24 determination is made that another grid row has an entry that indicates that its  
25

1 associated data stream source desires to be routed to the primary output of the  
2 matrix switch at the same time.

3  
4 **58.** The computer-readable media of claim 57, wherein the instructions cause  
5 the computer to change said at least one data value responsive to a transition that  
6 is defined to occur between two data stream sources.

7  
8 **59.** The computer-readable media of claim 57, wherein the instructions cause  
9 the computer to change said at least one data value responsive to an effect that is  
10 applied on a data stream source.

11  
12 **60.** A data stream processing method comprising:  
13 receiving at least one digital data stream using a software-implemented  
14 matrix switch having a primary output and at least one other output;  
15 routing said at least one digital data stream to said at least one other output;  
16 outputting said at least one digital data stream at said at least one other  
17 output;  
18 processing said at least one digital data stream to provide a different digital  
19 data stream;  
20 inputting the different digital data stream into the matrix switch; and  
21 routing the input different digital data stream to the matrix switch's primary  
22 output.

1 **61.** The data stream processing method of claim 60, wherein said receiving  
2 comprises receiving multiple streams and routing multiple streams to individual  
3 other switch outputs.

4  
5 **62.** The data stream processing method of claim 61, wherein at least some of  
6 the multiple streams comprise video streams.

7  
8 **63.** The data stream processing method of claim 61, wherein at least some of  
9 the multiple streams comprise audio streams.

10  
11 **64.** The data stream processing method of claim 60, wherein said processing  
12 comprises transitioning from one stream to another stream.

13  
14 **65.** The data stream processing method of claim 60, wherein said processing  
15 comprises using two video data streams to provide a video data stream containing  
16 portions of both video data streams.

17  
18 **66.** The data stream processing method of claim 60, wherein said processing  
19 comprises applying an effect on said at least one digital data stream.

20  
21 **67.** The data stream processing method of claim 60, wherein said processing  
22 comprises mixing multiple digital data streams.

23

24

25

1 68. The data stream processing method of claim 60, wherein said processing  
2 comprises mixing multiple audio or video digital data streams.

3  
4 69. One or more computer-readable media having computer-readable  
5 instructions thereon which, when executed by a computer, implement the method  
6 of claim 60.

7  
8 70. A data stream processing method comprising:  
9 receiving at least one digital data stream using a software-implemented  
10 matrix switch object, the matrix switch object being configured to receive one or  
11 more digital data streams and output at least one digital data stream, individual  
12 digital data streams comprising portions of a user-defined multi-media editing  
13 project comprising one or more of video data streams and audio data streams;  
14 outputting, from the matrix switch object, at least one digital data stream;  
15 receiving, with another object, the output digital data stream;  
16 processing the received digital data stream to provide a different digital data  
17 stream;  
18 receiving the different digital data stream with the matrix switch object; and  
19 outputting the received different digital data stream as a primary output  
20 stream that represents the user-defined multi-media editing project.

21  
22 71. An input-managing system comprising:  
23 a software-implemented matrix switch having multiple input pins and  
24 multiple output pins, the input pins being individually associated with inputs that  
25

1 can compete, during a common time period, for a particular output pin that is  
2 associated with the matrix switch; and

3 a data structure associated with the matrix switch and configured for use in  
4 programming the matrix switch to provide a routing scheme for routing input pins  
5 to output pins such that at any given time, only one input pin is routed to the  
6 particular output pin.

7  
8 **72.** The input-managing system of claim 71, wherein the input pins are  
9 configured to receive digital data streams.

10  
11 **73.** The input-managing system of claim 71, wherein the input pins are  
12 configured to receive digital video data streams.

13  
14 **74.** The input-managing system of claim 71, wherein the input pins are  
15 configured to receive digital audio data streams.

16  
17 **75.** The input-managing system of claim 71, wherein the input pins are  
18 configured to receive digital video and audio data streams.

19  
20 **76.** The input-managing system of claim 71, wherein said data structure  
21 comprises a grid structure.  
22  
23  
24  
25

1 77. The input-managing system of claim 71 further comprising a second data  
2 structure associated with and different from the first-mentioned data structure, the  
3 second data structure being configured for deriving the first-mentioned data  
4 structure.

5  
6 78. An input-managing system comprising:

7 a software-implemented matrix switch object configured to process  
8 multiple inputs and provide one or more outputs, one of the outputs comprising a  
9 primary output for which contention can take place between the multiple inputs;  
10 and

11 a data structure associated with the matrix switch object and configured for  
12 use in programming the matrix switch object to resolve contention issues between  
13 the multiple inputs.

14  
15 79. A multimedia system comprising:

16 an application program configured to enable a user to define a multi-media  
17 project in which multiple digital source streams can be combined;

18 a software-implemented matrix switch having multiple input pins and  
19 multiple output pins, the input pins being individually associated with inputs that  
20 can compete, during a common time period, for a particular output pin that is  
21 associated with the matrix switch, the switch being configured to receive, at its  
22 input pins, digital source streams;

23 a first data structure associated with the matrix switch and configured for  
24 use in programming the matrix switch to provide a routing scheme for routing  
25



input pins to output pins such that at any given time, only one input pin is routed to the particular output pin; and

a second data structure associated with and different from the first data structure, the second data structure representing a user-defined multi-media project and being configured so that the first data structure can be derived therefrom.

**80.** The multi-media system of claim 80, wherein the first data structure comprises a grid structure.

**81.** The multi-media system of claim 80, wherein the second data structure comprises a tree structure.